Lone Genius or Swarm Intelligence? Myths about Germany's Sponsorship of Research Institutes

Justin J.W. Powell and David P. Baker

Abstract
Countries around the world have emulated Germany's model of the university devoted to research-based teaching. The independent, extra-university research institute led by a leading "genius" scientist was also developed in Germany. In recent decades, Germany's research budget and science system continue to be split between its universities, which are relatively underresourced, and institutes enjoying favored sponsorship and significant funding. We argue that Germany could be even more productive with stronger support for the *research university*.

Scientists in Germany publish more articles in leading journals than those in any other nation, except the United States and China. But unlike in the United States and many other countries, Germany's scientific community is significantly split between universities, which enjoy relatively similar reputations while suffering chronic underfunding, and independent research institutes, led by selected individual "geniuses" and receiving considerably more funding. Under this dual-pillar policy approach, universities are supposed to specialize in the education of the next generation of scientists, whereas cutting-edge research is thought to be the preserve of hundreds of renowned—and much better resourced—independent research institutes.

Germany's research institutes are organized under large umbrella associations: the Max Planck Society (1948), Fraunhofer Society (1949), Leibniz Association (1990), and Helmholtz Association (2001), each with tens of thousands of scientific personnel with few, if any, teaching obligations. In 2017, Germany spent 3 percent of its considerable GDP on R&D, and thus achieved the European Union's recommended target by spending among the highest rates in the European Union. Yet its universities received only 17 percent of these funds; a significantly larger share went to the institutes, usually funded jointly by federal and state (*Länder*) governments. Thus, this dual-pillar policy represents a counterfactual case to understand the relative importance of universities in science production, which we discuss in our forthcoming book *Global Mega-Science: Universities Scientize the World* (Stanford University Press).

Dual-Pillar Research Policy Myths

Despite their more modest funding per capita and less than optimal research environments—not to mention their growing teaching and training responsibilities, as higher education participation rates have massively increased—universities' outstanding performance belies the myth that research institutes are where almost all significant German science is conducted. In fact, universities produce the majority of new German scientific and technological research. Recently, after an analysis of over 176,000 STEM+ journal articles with at least one Germany-based author since 1950, we found that for every new discovery that institutes publish, universities produce three.

A core tenet of the myth about institutes is the belief that relieving researchers of teaching and administrative responsibilities necessarily makes them more productive.

Also, a core tenet of the myth about institutes is the belief that relieving researchers of teaching and administrative responsibilities necessarily makes them more productive. Yet, this likely provides only a modest advantage. While institute scientists are more productive than university scientists, it is only by an estimated quarter of a paper per annum per researcher. Indeed, to match universities' huge aggregate research output, Germany's already high spending on institutes would need to increase by two-thirds, an unrealistic proposition.

Another popular myth is that institute scientists will use their better-funded research environments to collaborate with their busier university colleagues. But, despite several initiatives, this has been slow to happen, as institute/university coauthorships increased from just 3 percent to 12 percent of all publications between 2000 and 2010. Further, planned bridges between these two sectors, such as joint graduate and doctorate programs shared by both organizational forms, remain only partially built. Even in an era

of collaboration, communication between scientists in the country's different organizational forms is hindered by segregation and huge prestige differentials.

Perhaps the most cherished belief of all is in the superiority of the science produced in institutes. But, while institute-based researchers, often focusing all their energy on specialty fields, do produce many high-impact papers, universities publish twice as many papers in the leading journals, often collaborating with researchers from all other science-producing organizational forms. And while institutes extend scientific enquiry, acting as catalysts for the science system overall—and collaborate with leading scientists worldwide—universities publish on a broader array of scientific topics and collaborate more intensely via their embeddedness in diverse networks, educational and scientific. Also, scientists from both sectors win major scientific prizes such as the Nobel.

In some ways, none of this is surprising. After all, there are far fewer institute scientists; institutes have around one-sixth of university personnel. But the universities' achievements are remarkable, given that their funding has not kept pace with the substantial rise in student enrollments and the lack of dedicated research infrastructure that institutes enjoy. Heavy investment in the lone genius model may no longer make perfect sense in a world of global megascience, in which investment in the largest community of collaborating scientists possible is key. If policy moved in this direction, German universities could do so much more.

Yet research policy continues to emphasize increasing resources for institutes—while university-based scientists are relegated to fighting for competitive funding programs. And since tuition fees are almost nonexistent, universities can hardly cross-subsidize research with tuition as their American counterparts do.

Since the 1960s and especially over the past decade, chronic underfunding and expanding student enrollments have forced German universities to direct most of their allotted funding to teaching, rather than research, and professors have heavy teaching loads. Scarce research funding has become ever more crucial to help sustain university infrastructure—and provide support for young researchers. Several rounds of the national Excellence Initiative program, for example, have emphasized this competitiveness, yet have only provided quite modest, fixed-term funding enhancements for the winning universities. Research institutes, by contrast, have had steadily increasing budgets—and are now allowed to compete for additional research funds. While institutes do provide ideal research conditions for younger scientists, universities are still responsible to provide their educational programs and certificates.

The "Humboldtian" University Model: Emulated More Successfully Abroad

Elsewhere, country after country has emulated Germany's "Humboldtian" model of the research-oriented university that integrates research and teaching. The scientifically leading United States and the rising powers of China and South Korea, among others, have quickly and massively increased their science capacity by focusing their research efforts on developing their higher education systems overall to become successful collaborators—not only a few prominent universities. This general state support for all universities was, after World War II, the key to rebuilding German science. And it was the secret behind the extraordinary and sustained pure exponential growth in new discoveries over "the century of science."

Worldwide, university-based scientists now contribute to between 80 to 90 percent of the more than 2 million articles published annually. Thus, it is ironic that while Germany gave the world the research university model, in recent decades, it has not supported its own universities' research capacity at world-class levels. Germany should soon rectify this mistake by increasing overall funding (not only of highly competitive programs with modest success rates such as the "Excellence Initiative," but more generally). As universities worldwide provide the most essential platform for scientific exchange between scientists working in all organizational forms, policy must also more effectively facilitate collaborative activities between institutes and universities. In so doing, the country would make more optimal use of its large R&D budget. This would help Germany retain its advantage in an era of ever-greater global scientific competition. ◢

Justin J.W. Powell is professor of sociology of education at the University of Luxembourg. Email: justin.powell@uni.lu.

David P. Baker is professor of sociology, education and demography at Pennsylvania State University and guest professor at the University of Luxembourg. Email: dpb4@psu.edu.